Date: August 25, 1982

Subject: Primary Processes R & D
Monthly Report - August 1982

From/Location: E. L. Cambridge

To/Location: J. G. Kaufman

BASIC RESOURCES RESEARCH

Bauxite Evaluation

Calculation of mineralogical composites from wet chemical results using methods from the literature has shown acceptable agreement with XRD results. This further validates the procedures that have been set up.

Alumina Evaluation

200 pound samples of Alpart, Reynolds Corpus Christi (Sebree) and Kwinana (Columbia Falls) aluminas are being forwarded to Tucson. From these we will prepare samples for a complete evaluation by Alcoa Labs. We will retain samples for standardization purposes for our own procedures.

AD-117 Impurity Leaching from Alumina

Report 82-TP-6 "Impurity Removal from Clay-Derived Alumina by Acid Washing" by D. M. Blake was issued. Acid washing proved ineffective in reducing P_2O_5 and MgO to specification levels. Because of the potential benefits of eliminating the recrystallization operation it was recommended that other potential alternatives be investigated. A project proposal for 1983 was prepared.

AD-105 Ammonoalunite Process

An up-dated economic evaluation of this process was initiated to define the economic potential and provide information for project planning and assessment.

AD-120 Anaconda $AlCl_3$ Process

a. Reductant Pre-Treatment

Further experiments were carried out with Collier coke to determine resulting chlorinated hydrocarbon levels over the complete 650-950°C temperature range. Duplicate samples of $AlCl_3$ produced with this reductant have been sent to Spectrix in Houston and Industrial Labs in Denver for C_xCl_y (PCB's) analysis.

Experiments comparing Collier and Arco cokes as a reductant indicated that coke source has no effect on the important technical parameters (C_xCl_y results have not been received). However, Arco had 5% less weight loss from the pre-treatment, probably because of the greater density.

b. Chlorination

Chlorination experiments were carried out with high surface area Australian Brown Coal char (200 m^2/g) to identify the limiting factors for chlorination kinetics. This is not considered to be an economical reductant. Results indicate that kinetics are governed by the lowest surface area feed, PCACH or reductant. In our case this is the reductant, so that maximizing surface area at 850°C also provides the best kinetics. Any further enhancements to increase coke surface area (up to the surface area of PCACH) would likely further increase chlorination kinetics.

Additional experiments, comparing partially calcined alumina trihydrate and ACH, confirm that residual hydrogen is consistently lower in ACH than tri-hydrate and the mole ratio of Cl to H is a maximum of 1.5 at 700°C.

c. Other

The following patent application was forwarded to the U.S. Patent Office:

> "Acid Melt Treatment to Activate Carbon for Use as a Reductant" by R. O. Loutfy and J. C. Withers.

The patent application draft for "Chlorination Using Partially Calcined Coke as a Reductant" by R. O. Loutfy, J. C. Withers, S. S. Jones and S. K. Das was received from the attorney. This will be reviewed and returned as soon as possible as this is a key factor in our process.

Preparations for the Alcoa exchange meeting are proceeding on schedule.

Alumina Related Chemicals

A draft report was prepared for the committee's use in analyzing opportunities in this area. Some potentially interesting possibilities were identified from Mr. R. Getty's recent visit to Louisville.

REDUCTION RESEARCH

AD-108 Process

A 34-day operating campaign with a 40 percent AlF_3, 30 percent LiF, 20 percent NaCl and 10 percent NaF electrolyte gave economically unacceptable losses of LiF and Cl. This work will continue to optimize electrolyte composition.

Work continued to optimize pre-bake composite anode formulation. Improvements in anode density and conductivity can potentially be achieved by changing the alumina aggregate distribution to increase packing density. The current formulation gives an estimated 40 percent void space in the anode.

Closed cell electrolysis with off-gas monitoring indicates that no chlorine is evolved with a chloride component in the electrolyte up to 17 amp/in^2 current density. Mixed halide electrolytes could therefore be used at commercial current densities to improve electrolyte properties.

AD-119 Low-Temperature Electrolytes

A specially prepared, high surface area (200 m^2/gm) alumina was successfully dissolved and electrolyzed in a 750°C all-fluoride melt. Current density was raised up to 9 amps/in^2 without experiencing anode effect. These preliminary results are encouraging. A more detailed literature search and further experiments are planned.

AD0116 Potlining Resource Recovery

A feasibility study report was jointly issued by Anaconda and Alcan. The report represents the culmination of a nine-month effort to define the technical basis from which the two companies can pursue a potlining recovery project. R & D project proposal documentation was completed and submitted.

DEVELOPMENT & TECHNICAL SERVICES

Pot Magnetics - Columbia Falls

The metal pad in pot 304 has been reduced to 15½ inches from its 17½ inch level prior to the bus conversion in July. As a result of the increased bath volume and reduced metal pad, the anode effect frequency has decreased significantly.

The newly designed magnetics probe shield was constructed and tested. A maximum temperature of 40°C was reached in the probe zone during a fifteen-minute test with no apparent damage to the shield. The plan is to take the first magnetic profile data during the week of August 23, 1982.

Continuous Pot Temperature Measurement

A literature search has revealed two patents of particular interest. The first is an Alcoa patent which describes thermocouples welded to the shell just below the bath-metal interface. The second is an Alusuisse patent describing the use of an electrically conductive material for a thermocouple tube. The tube is made cathodic by connecting it to the cathode bus of the downstream cell thereby forming a protective layer of molten aluminum between the tube and the bath. The literature search has uncovered no material which is a proven candidate for simple direct continuous temperature measurement.

Samples of Si_2ON_2, Si_3N_4, AlN and vitreous carbon have been received. A sample of TiB_2-BN composite material should be received shortly as well as a furnace to conduct corrosion tests. Contact has been made with the Illinois Institute of Technology to determine possible methods of closing the surface of Si_3N_4 and other related materials. A brochure from Cerac, Inc. indicates that TiN and ZrN have good resistance to cyrolite. Other areas which warrant investigation include surface coatings of exotic materials resistant to oxidation and cryolite corrosion onto graphite or refractory hard metals (to be applied in the context of the Alusuisse patent).

Columbia Falls Anode Optimization

Modification of the coke aggregate size distribution from the first test campaign increased the vibrated dry bulk density from 1.187 (Columbia Falls standard aggregate) to 1.251 g/cc. This work continues as planned. First phase results are due September 3.

Sebree Large Anode Project

Nine hundred phase II test anodes have been pressed and are now being baked. New baking practices were developed to assure complete baking of carbon outside of the normal bake zone. The plan is to begin setting the test anodes by the first of October.

Mitsubishi Technology

A meeting was held between Anaconda and Mitsubishi at Columbia Falls. After inspecting the paste plant, Mitsubishi concluded that Columbia Falls can utilize their technology. The primary process change will be the addition of a fourth screen fraction. Mitsubishi has 30 days to make a formal response, and at that time a contract will be forwarded to Louisville for consideration.

Columbia Falls Lithium Fluoride Test

Test pots remain stable. Bath temperatures are running 7°C below plant normal. Some questions have developed concerning the validity of the lithium analyses issued by the Columbia Falls lab. An investigation is underway to solve this problem.

Reduction Technical Workshop

The two-day workshop is scheduled to be held at Sebree beginning September 22. Both Columbia Falls and Tucson will be sending three representatives. Tucson is responsible for formulating a detailed agenda with input from each plant.

PERSONNEL

Suzanne Young joined the Reduction group on August 9, 1982 as a Research Engineer. She is a recent M.S. (Chemical Metallurgy) graduate from Columbia.

We are presently recruiting for 3 technician positions.

E. L. CAMBRIDGE

ELC:pm

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